Abstract

Adaptive management on rainfed agricultural ecosystem is crucial to improve field productivity and soil carbon sequestration under climate change, particularly in semiarid east African Plateau (EAP). We first introduced ridge-furrow (RF) farming system with plastic mulching and balanced fertilization into EAP to explore its effects on maize growth, yield formation, water use and soil carbon sequestration in a typical semiarid site of EAP in long but cool (2012) and short but warm (2013) rainy seasons. Local maize (*Zea mays* L.) hybrid, *KCB* was used in field experiments including three farming patterns: 1) conventional flat planting (FP); 2) RF with transparent polyethylene film (RFT) and 3) RF with black polyethylene film (RFB), in which each pattern was exposed to high fertilization (compound fertilizer) (375 kg ha^{-1}), conventional fertilization (225 kg ha^{-1}) and zero fertilization respectively. The results indicated that RFT and RFB treatments significantly increased soil water storage in the depth of 0–120 cm, aboveground biomass, grain yield and water use efficiency over two growing seasons. On average, fertilization treatments further increased biomass accumulation, grain yield, leaf area index and WUE by 24.3%, 13.1%, 18.7% and 9.6%, respectively on the basis of sole RFM treatment. Across two seasons, RF mulching with fertilization averagely increased soil organic carbon and C/N ratio (soil organic carbon/soil total nitrogen) by 5.1% and 10.7% respectively. Critically, increased root biomass resulted in more root residue import into soil system due to improved hydro-thermal balance, which may account for biological carbon sequestration effects in this system. In addition, our field demonstration suggested that local farmers benefited from higher economic return from this integrated farming system, showing a high acceptance extent. Taken together, this system could serve as a promising adaptive management on increasing agricultural carbon fixation and maize productivity to cope with food security and climate change in semiarid EAP and other similar areas of Africa.